THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

With output each day averaging more than 1,000 tons, the operations of Evan Jones Coal Company at Jonesville, Alaska, 65 miles northeast of Anchorage, are spearheading the rapid advance of the coal production industry in the territory. Mining activities are carried on under Wishbone Hill at the approaches of the Talkeetna Mountain Range. The coal deposit under the hill is in the Chickaloon seam—a high-volatile B bituminous coal of a friable nature.

The company's activities include both underground and strip mining. The output from the strip mine is small. Plans are underway to increase production from stripping in 1954. In the underground mine, two operating methods are used, the standard room-and-pillar in the 6-ft. No. 3 seam, and the cross pitch in the 20-ft. No. 5 seam. Blasting in these two seams with 20% permissible explosives produces close to 80 per cent coal.

A summary of the methods and equipment used in this coal mine in Alaska is presented in the article beginning on page 103.

* * *

When in operation, all transmitters of radio and related radio-frequency (RF) services create a field of electrical energy in the air surrounding their antennas. Under exceptional instances, electric blasting caps may pick up enough of this energy to cause them to explode. However, from a practical standpoint, the possibility of a premature explosion due to RF energy is extremely remote.

The Institute of Makers of Explosives published a pamphlet recently which contains the most up-to-date information on this subject available to the editors at the present time. Please turn to page 116.

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SUBSCRIPTION RATES: *United States and Canada*—One Year, $1.50; Single Copies, $.30. *Limited Subscriptions Only to Other Countries*—One Year, $2.50; Single Copies, $.50.

The Explosives Engineer, 913 Delaware Trust Building, Wilmington, Delaware. Printed in United States of America.

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Published by HERCULES POWDER COMPANY

VOL. 31 NO. 4 JULY-AUGUST, 1953

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

In recent months, the operating personnel of Bethlehem Steel Company's plants in Pennsylvania have been wrestling with the problem of low yields from metallics charged into the furnaces. Test heats showed that No. 2 bundle scrap was the culprit. An intensive inspection program was adopted and startling revelations were uncovered.

Numerous methods were used to open bundles for internal inspection. All proved impractical for reasons of time, low production, expense, and distortion and destruction of the contents. Finally, the problem was solved by blasting open the bundles with small charges of dynamite. A description of this unique inspection procedure will be found in the article on page 108.

* * *

For many years, at varying intervals, city officials of Holyoke, Massachusetts, had to place large quantities of fill on a section of highway which crossed a swamp 650 ft. long made up of muck and peat 20 to 40 ft. deep. The successive fill placements would gradually sink and the surface of the road lowered below the grade of the highway.

To correct this situation, the State Department of Public Works awarded a contract last October which called for blasting in the swamp muck under heavy fill placements until the fill was settled on a secure foundation. The procedures followed in solving this troublesome highway problem are included in the article on page 112.

* * *

A review of the Southwestern Puerto Rico Project, an ambitious construction program for the development of the Island's water resources for irrigation, power, and water supply, will be found in the article beginning on page 118.

"For branch lines I use a half-hitch—pulled up tight

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XR53-3

Armstrong Robertson Matthews

PRESIDENT

POCAHONTAS FUEL COMPANY
INCORPORATED

A Biography

THE success story of Armstrong Robertson Matthews exemplifies once again the rewards that accrue from the application of sound training and wide experience, coupled with engineering and organizing talents. His appreciation and understanding of his fellowmen are reciprocated by the admiration and loyalty of his associates.

"Army," as he is known to his friends, was born in Nashville, Tennessee, May 8, 1902, the son of Harley and Edine (Armstrong) Matthews. His parents are of colonial ancestry: the Matthews family were early settlers in Virginia, and the Armstrong family in Maryland. After finishing the sixth grade in a local public school, Army completed his college-preparatory studies during the next five years at Montgomery-Bell Academy in Nashville. Following his graduation from the Academy, he went to Vanderbilt University in Nashville. At the end of the freshman year, he transferred to Lehigh University at South Bethlehem, Pennsylvania, and was graduated with the class of 1925, with a degree of Engineer of Mines.

Army went to work for the first time at the age of sixteen, as a night substation operator for the Nashville Railway and Light Company. Later, during summer vacations from college, he was employed on various assignments at the Indianola, Pennsylvania, mine of Inland Steel Company.

Soon after graduating from Lehigh, Army accepted a position with Tennessee Consolidated Coal Company and was placed in charge of the company's engineering projects. After a brief period, he left Tennessee Consolidated to return to Inland Collieries Company for special duties. Shortly thereafter, he became associated with Consolidation Coal Company and, for the next three years, was a member of the staff of its engineering department.

In 1929, he was moved into the operating end of Consolidation's activities, becoming division superintendent of the company's Pocahontas New River Division, with headquarters in Coalwood, West Virginia. Later, he was transferred to the company's Fairmont Division in the same capacity.

He left Consolidation Coal Company in 1933, to join the engineering staff of The Philadelphia and Reading Coal and Iron Company. After two years in the anthracite field with P&RC&I, he resigned to accept the job of manager of operations for Clover Splint Coal Company in West Virginia.

When Clover Splint Coal Company was sold to Pittsburgh Consolidation Coal Company in 1944, Army became associated with Clinchfield Coal Corporation as executive vice president. Two years later he was elected president of the corporation. In 1951, he resigned from the Clinchfield organization to accept the presidency of Pocahontas Fuel Company Incorporated, Pocahontas, Virginia, the position he holds at present.

Armstrong Robertson Matthews married Elizabeth Sampson on June 10, 1937, at Harlan, Kentucky. They have one daughter, Elizabeth Bentley Matthews. The family home is at 725 Heatherwood Road, Bluefield, West Virginia.

Mr. Matthews' club affiliations include the Engineers, the Metropolitan, and the Uptown in New York City, and the University and the Bluefield Country in Bluefield. He is a member of Sigma Chi Fraternity.

Army has been an enthusiastic hunter and fisherman since boyhood days. In recent years, his activities in fields and streams have been limited because of the demands of his business responsibilities. However, when time and opportunity permit, he still finds relaxation in quail and duck shooting and in fishing.

ARMSTRONG ROBERTSON MATTHEWS

Editorial

Blasting with Dynamite Accelerates Fill Settlement

Some years ago, the construction of a highway over a swamp required successive placements of large quantities of fill material over the right-of-way until the weight of the fill penetrated the soft ground and a solid foundation for the highway was secured. This procedure often took years, causing delays in permanent road construction plans or, more often, failure to produce a satisfactory highway.

In recent years, dynamite has been used with such success for fill acceleration in soft, mucky soil that its introduction has revolutionized embankment construction in many localities. The article beginning on page 112 of this issue presents factual data on how the use of dynamite made possible the construction of a modern roadway over a deep swamp in Holyoke, Massachusetts.

Highway engineers attempt to avoid roadway construction over soft ground. However, in some instances, there are no alternatives and roads have to be built over swamp land. With time an important factor to be reckoned with, it is fortunate that dynamite can be adapted to the acceleration of fill settlement in soft ground. It is another demonstration of the value of industrial explosives in overcoming troublesome construction problems quickly, effectively, and economically.

Mining Men to Meet in Seattle, September 21-24

Mining men from all parts of the United States and Canada will be present when the 1953 metal and nonmetallic mining meeting of the American Mining Congress convenes in a four-day session at Seattle, Washington, September 21 through 24.

The program of speakers and the subjects scheduled for discussion at this year's meeting promise to be of particular interest. The relationship between the Government and the mining industry will be spotlighted and solutions sought to problems that are troubling the industry. Douglas McKay, Secretary of the Interior, will review the Government's policies and Arthur S. Fleming, Director of the Office of Defense Mobilization, will present a report on the progress being made in defense mobilization and outline the plans for the future.

Conferences will be held for informal discussions of strategic metal and nonmetallic minerals, and other subjects of special importance. The latest developments in methods and equipment for underground and open-pit mining, for improved recovery of metals and minerals, and for greater safety will be thoroughly reviewed.

On the convention's agenda are such timely subjects as new methods for prospecting and the determination of ore bodies, the trends in drilling and blasting, roof support and rock bolting, ventilation and dust control, trackless mining, grinding and concentrating, and metal extraction.

The 1953 meeting should prove to be of exceptional value, not only in the usual sense of bringing metal and nonmetallic mining men together for exchange of mutually beneficial information, but also in the sense of setting the stage for coordination of efforts toward efficient maximum production of needed minerals.

Help to Prevent Children from Playing with Blasting Caps

Statistics compiled by the Institute of Makers of Explosives show that 81 children were injured last year from playing with blasting caps. The number of these accidents is small as compared with the total number of all types of accidents to children each year. The essential fact remains that *all* of the 81 accidents could have been avoided if every person responsible for the storage, disposition, and use of blasting caps had exercised proper care in preventing blasting caps from getting into the hands of children.

In 1927, the Institute started a campaign aimed at educating children and their adult supervisors of the dangers of blasting caps as playthings. Since that time, the number of accidents has been materially reduced. However, there will be no letup by manufacturers and users of explosives until accidents from this cause are entirely eliminated.

In carrying on its campaign, the Institute has enlisted the aid of many public groups. The schools of the nation, the Boy Scouts and the Girl Scouts of America, the newspapers and radio stations, the policemen and firemen, the county agents, and many branches of the Federal Government, all have made definite contributions in the effort to save children from accidents from blasting caps.

Of special help is the active support of civic groups in mining communities. The efforts they put forth are especially effective because they bring home the safety lesson about blasting caps in areas where children are most likely to find them.

Any group or organization interested in joining the crusade may obtain literature and posters, especially designed for children, from the Institute of Makers of Explosives, 250 East 43rd Street, New York 17, New York.

ALASKA'S NO. 1 COAL PRODUCER: The progressive management and modernized operations of the Evan Jones Coal Company, Jonesville, Alaska, 65 miles northeast of Anchorage, are spearheading the rapid advance of the coal mining industry in the territory.

THE EVAN JONES COAL MINE IN ALASKA

Averaging more than 1,000 tons a day, Alaska's largest producer has increased output 35 per cent in the last two years

BOB KEDERICK*

With production averaging more than 1,000 tons a day, the operations of the Evan Jones Coal Company's mine and plant at Jonesville, Alaska, are spearheading the rapid advance of the coal mining industry in the territory. The company's property is located about 65 miles northeast of Anchorage, Alaska's largest city. Mining operations are carried on under Wishbone Hill on the northern edge of Matanuska Valley, at the approaches of the Talkeetna Mountain range. The coal deposit under the hill is in the Chickaloon seam. The beds of coal being mined are high-volatile B bituminous of a friable nature.

Evan Jones was the original prospector at the mine's location and, subsequently, organized the company which bears his name. He was its president until the mid 1920's (he died in 1948). Mr. Jones obtained a long-term lease from the government covering an area of 2,348 acres of land. The leased acreage included units 5 and 6 of the Matanuska coal field on the fringe of the territory's principal agriculture sector.

Despite a combination of transportation and weather problems peculiar

*Night News Editor
Anchorage Daily News
Anchorage, Alaska

to Alaska, the development of the Evan Jones mine has progressed to the point where current employe requirements total more than 250. Housing, one of Alaska's chief problems, is maintained at the mine site for about 90 employes. The remainder live in nearby Wasilla, Palmer, and Eska. The introduction of modern equipment and operating methods has made it the most up-to-date coal mine and plant to be found in the territory. Up until two years ago, all electrical power consumed at the mine was produced with Diesel generators and steam turbine. With the growth of Matanuska Light and Power Company, located 15 miles to the south, in Palmer, facilities for the use of commercial power have been installed.

Combatting the "Coal Crisis"

Under the leadership of President Harry Hill, a veteran Alaskan mining executive, the Evan Jones operations are front-running the territory's effort to combat the "coal crisis" posed by the increasing requirements of the Armed Forces establishments. The growing needs of these rapidly expanding defense units for coal, both for heating and power production purposes, must be satisfied. If this is not done, Alaska's coal industry will meet with serious competition from imported coal and from the conversion of present coal-burning facilities to oil-burning facilities.

More than 90 per cent of the coal produced by Evan Jones Coal Company goes to the two military installations in the Greater Anchorage area — Elmendorf Air Force Base and Fort Richardson. Federal contracts for coal supplies are awarded on a fiscal basis. A small percentage of the company's production is sold to homesteading settlers throughout the area for domestic consumption.

Coal is transported from the mine to the military installations in Anchorage by railroad cars of the Alaska Railroad, which are loaded direct at the washing plants. The Alaska Railroad is government-operated and is the chief rail carrier in the territory. Branch lines have been installed direct to the mine site. Wishbone Hill is about two miles off the Glenn Highway, one of Alaska's main arteries, and a well-conditioned unpaved road handles traffic from the highway to the mine location.

Until 1953, the Alaska Railroad bought about 50,000 tons of coal a year for its numerous locomotives. During a recent rehabilitation program, most of its rolling stock was converted to Diesel power. As a consequence, the railroad's coal purchases have dropped to about 500 tons a month.

Both underground and strip-mining operations are used at the Evan Jones property. Underground activities have been carried on continuously since 1921, making it the oldest mine in Alaska with a record of uninterrupted operations. The output from the strip mine is small. Plans are under way to increase production from stripping during 1954.

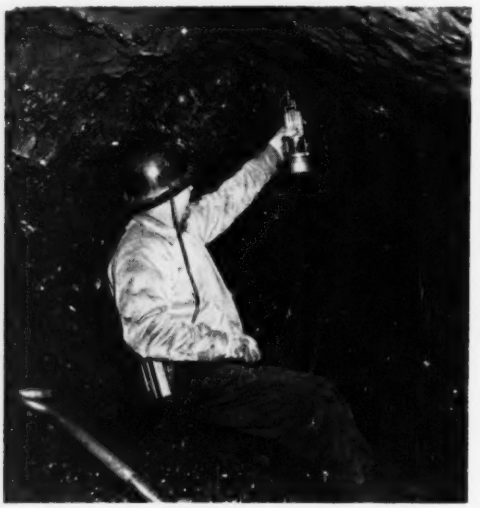
Wishbone Hill, approximately 1,600 ft. high, with its base about 825 ft. above sea level, is part of a conglomerate hill with heavy reserves of coal. It is estimated that these reserves will make possible a continuance of the present rate of mine production for at least a year without making a major operating move.

Equipment

Being Alaska's largest coal producer, it is understandable that the Evan Jones mine employs the widest assortment of up-to-date equipment to be found in the territory. Four air hoists are used to haul timber, men, and supplies within the mine. All underground electrical equipment is operated by 220-volt alternating current power circuit. Four shaker conveyors transport coal from cross-pitch mining rooms to gravity chutes. A Joy 7BU loader operating in the No. 5 seam loads coal direct into mine cars. A Joy 7B cutting machine is operated to undercut the main gangway face. Equipment for rock dusting has been ordered and is expected to be available for use before the end of the year.

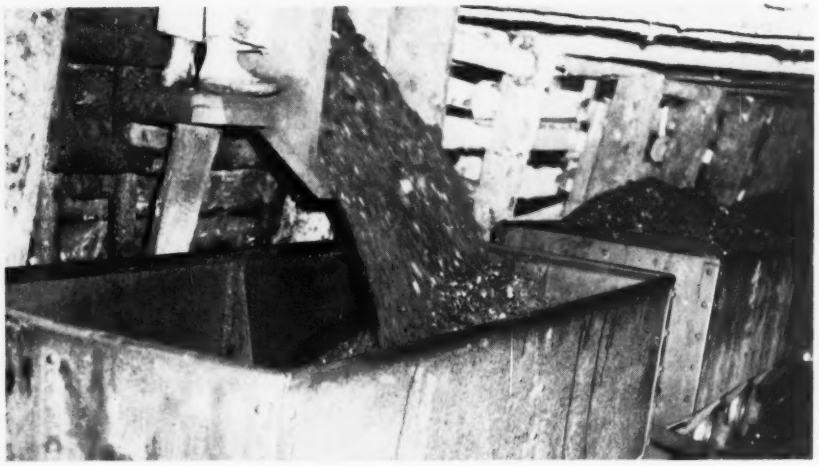
Five air compressors are in operation, two of which provide the major portion of compressed air that is fanned into the mine. These two are Ingersoll-Rand Model 75's, with 600-c.f.m. capacity. A Chicago Pneu-

STEMMING A DYNAMITE CHARGE: After a drill hole is loaded with a charge of permissible dynamite, the hole is stemmed to collar with prepared sand or clay.



INSPECTING WORKING PLACES: Before and after blasting, the shot firer inspects for gas.

READY TO BLAST: The leg wires of the delay electric blasting caps, comprising first through eighth period of delay, have been connected and a blast in the coal seam at a working place in the Evan Jones mine is ready to be detonated by the shot firer.



LOADING COAL CARS: Following a blast, the broken coal is dumped down gravity loading chutes into 3-ton Sanford Day bottom-dump cars for transportation to the tipple.

matic 500-c.f.m. compressor is also in use to provide air for the approximately 2-mile-long mine and the four receiving tanks. Two Ingersoll-Rand electric compressors are maintained for standby.

Because of extreme cold during the winter, a mixture of Tanner gas is placed in air lines to prevent formation of moisture which would quickly freeze in temperatures that normally hover several degrees below zero.

Operating Methods

Two operating methods are used in the underground mine, the standard room-and-pillar in the No. 3 seam and the cross pitch in the No. 5 seam. These two seams are the only ones being mined at present. Company officials anticipate mining seams Nos. 6 and 7 at an early date. The latter seams are 6-ft. beds in which rooms and pillars will be developed.

In the No. 3 seam where standard rooms and pillars are employed, chutes are driven to the outcrop and brought back simultaneously on retreat from the outcrop. Instead of using one main gathering chute, the mine cars are loaded at individual chutes.

In the No. 5 seam, chutes are driven to the outcrop at right angles with the main gangway. Panels are then placed on the right and left. Rooms and pillars are developed on 50-ft. blocks, with the pillars placed on 50-ft. centers. The length of the chutes is driven approximately 1,600 ft.; some are driven through to the surface for ventilation and escape-way purposes.

In both No. 3 and No. 5 seams, the chutes are driven up the pitch, which varies between 35 and 40 degrees. At present, the mine has worked about 120 chute lengths in the No. 3 seam, and 80 in the No. 5 seam. The average size of the chutes is 6 by 12 ft. They are lined with 3-ft.-wide sheet iron which allows sliding and gravity loading of blasted coal.

The mine has been classified gassy. Ventilation is induced by two axial-flow fans blowing about 95,000 cu. ft. of air a minute into Nos. 3 and 5 seams. Stoppings between gangways and counter gangways are made of wood, and doors are erected in pairs.

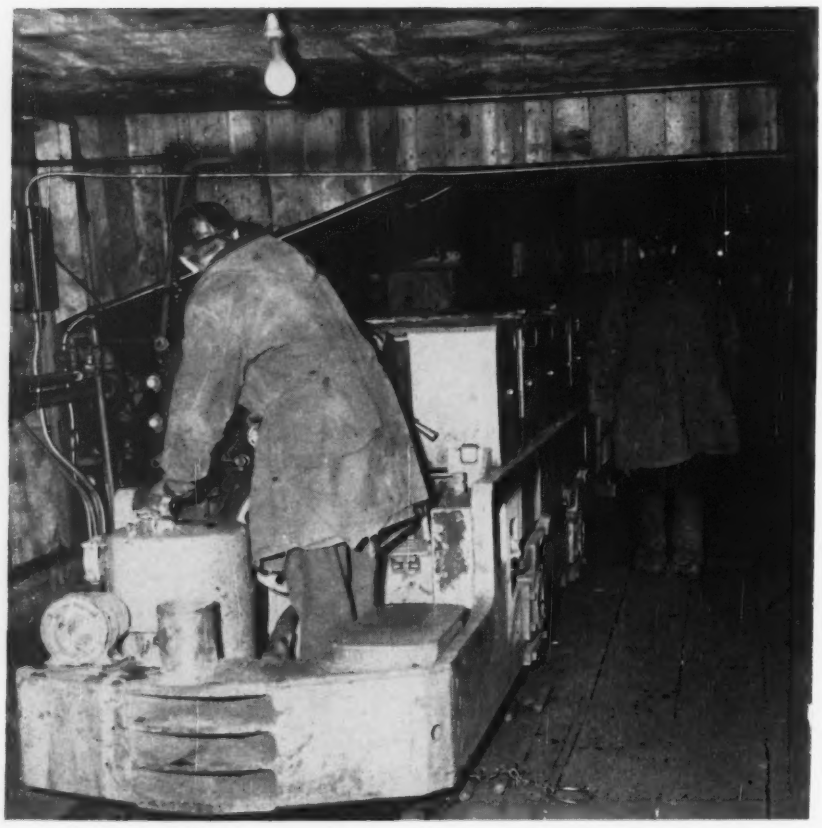
Blasting

Blasting in the 6-ft. No. 3 seam and the 20-ft. No. 5 seam produces close to 80 per cent coal. The two seams are interbedded with small quantities of sandstone and shale. The immediate roof in the No. 3 seam consists of 4 ft. of coal, while the main roof, which is soft sandstone and shale, caves readily during pillar extraction. The immediate roof in the No. 5 seam is made up of 14 ft. of coal; the main roof is formed of sandstone.

After a working face has been prepared with the operation of a Joy 7B cutting machine or with jackhammers, three rows of holes are drilled 6 ft. deep into the coal, using Chicago Pneumatic or Ingersoll-Rand jackhammers. The faces in the main gangway average 9 by 14 ft., and chute faces average 6 by 12 ft. Each drill hole is loaded with 1½ lbs. of 20 per cent permissible explosive, in 1¼ by 8-in. cartridges. The charges are primed with delay electric blasting caps, first to eighth periods of delay inclusive. The dynamite charges are stemmed with about 2 ft. of prepared sand or clay. Before and after blasting, the shot firer makes careful inspections with a permissible flame safety lamp.

Following a blast, the coal is removed to gravity loaders (sheet iron linings on the floor of chutes) by conveyors, mucking machines, or slushers. From the gravity loading chutes, the coal is loaded into 3-ton Sanford Day bottom-dump cars for transportation to the tipple. Dump cars are hauled by

MAIN GANGWAY: This view of the main gangway shows the tracks leading to working places in the No. 3 seam at left, and to operating activities in the No. 5 seam at right.



UNDERGROUND TRANSPORTATION: Trains of twelve bottom-dump cars loaded with coal are transported from the working places to the tipple by a battery-powered locomotive.

a battery-powered locomotive. Twelve dump cars make up a normal hauling load from mine to tipple.

Processing

Two plants are maintained for washing raw coal. The introduction of a modern heavy-media washing plant, the only one in the territory and one of the first six to operate in the United States and its possessions, is an example of the up-to-date equipment and operating methods adopted by the Evan Jones Company management. The media plant is a Mobile mill, purchased from Western Machinery Company. Three super diagonal concentrating tables are capable of handling 30 tons of fine coal feed an hour. The tables are products of the Deister Concentrating Company.

Adjacent to the media plant, a Forrester-type jig washing plant operates at a capacity of 50 tons of raw coarse coal feed an hour.

Both plants use water pumped in from Lake Eska, situated about a half mile from the plant sites. The peak consumption of water is 250 gallons a minute for the jig plant, and 500 gallons a minute at the media plant. Magnetite is mixed with the media plant water for gravity maintenance and separation of coal.

Flow of Coal

The coal flow through the heavy-media preparation unit starts when the 3-ton coal cars are tripped and closed with a mechanical device attached to a rail at the tipple. Coal from the cars is emptied into two 20-ton bins, each equipped with a reciprocating feeder that feeds onto a 30-in. belt conveyor. One man picks wood and large reject coal from the belt. The belt empties onto a 3 by 8-ft. double-deck Allis Chalmers vibrator with a 3 by 8-ft. screen on the top deck. The screen has 3-sq.-in. holes and acts as a scalping screen ahead of a 3XB Gruendler crusher set at 2½ in. The resultant coal from screen and crusher is moved on a 30-in. conveyor belt to a 4 by 12-ft. Allis Chalmers double-deck low-head vibrator raw coal preparation screen.

The top deck of the low-head vibrator has a 4 by 8-ft. screen with 1-sq.-in. holes. Minus ¾-in. raw coal is flumed down 8-in. pipes to three Deister tables by recirculating water

from slack boot and water tailings from a 36-in. magnetic separator. The bottom deck is screened with ⅜-in. holes.

Minus ⅜-in. coal is cleaned on three Deister cleaning tables and flumed to a slack boot or sludge tank from where it is moved on an 8-ft. drag conveyor to an 18-in. belt conveyor emptying it onto the clean coal conveyor. The minus ⅜-in. rejects from the Deister tables are flumed to a 30-in. spiral classifier and to a 12-in. single-chain drag conveyor to the reject bin.

The raw ⅜ by 3-in. coal goes to a 7-ft. heavy media cone, using magnetite as a medium and a center airlift for rejects. The clean ⅜ by 3-in. coal is removed to a 4 by 16-ft. single-deck Allis Chalmers low-head vibrator. The vibrator has a 4 by 16-ft. stainless steel punched plate for dewatering and the expulsion of magnetite. The lower half of the screen is equipped with spray bars which spray coal for the final removal of magnetite. The water-magnetite solution runs to a 36-in. separator which removes magnetite and pumps it to a densifier for storage and re-use. The water is recirculated to the Deister tables.

Final Separation

The removal of the ⅜ by 3-in. clean coal is accomplished on a 24-in. belt conveyor, mixed with minus ⅜-in. clean coal, and conveyed to the top of storage bunkers. From there it is dumped to a 3 by 10-ft. single-deck Allis Chalmers low-head vibrator with screen holes of 1¼ in. for final separation. Minus 1¼-in. coal is removed to a circular-type bin, and the plus 1¼-in. coal to another circular bin. These bins hold approximately 50 tons each.

The rejects from the airlift go to a 4 by 12-ft. Allis Chalmers low-head vibrator with a stainless steel ¼-in. punched plate. The rejects are dewatered and magnetite is drained and washed into a magnetite sump and a separator. An 18-in. belt conveyor transports rejects to a bin where a truck hauls it to the dump.

The jig washing plant flow begins at a 40-ton bin outside the mine where the coal is loaded into the bin from bottom dump cars which leave the mine in groups of 12.

From the bin, the coal is fed onto a 30-in. Link Belt conveyor by reciprocating feeders. Fed into a smaller bin by the conveyor belt, the coal is dropped by reciprocating feeders onto a single section, single-deck shaker screen inside the jig plant. The shaker has a screening area of 7 by 3½ ft. The coal is screened into two sizes — minus 2-in. steam and 3 by 2-in. nut. All the coal above 3 in. is hand picked.

The shaker screen sorts the coal into any proportions desired and drops it into another 40-ton bin. From the large bin, a chain conveyor places the coal into bucket elevators where it is delivered to the manually controlled Forrester-type jig washer.

(Continued on page 122)

CLEANING THE COAL: The coal is cleaned on three super-duty Deister diagonal-deck concentrating tables in the heavy media plant. Each table processes 10 tons of coal an hour.

HOMEWARD BOUND: At the end of a day shift in the Evan Jones mine, Foreman Andrew Norris and his crew of workmen ride out of the mine in empty Sanford Day coal cars.

BLAST IN ACTION: After holes in six selected bundles were loaded with explosives and the "all clear" signal given, the blast was fired with a conventional blasting machine. The results showed no destruction or distortion of the contents of the bundles.

DYNAMITE SOLVES

Bethlehem Steel Company's

SCRAP METAL INSPECTION PROBLEM

Blasting with small charges of dynamite opens hydraulically compressed bundles of scrap quickly, effectively, and economically for complete internal inspection

It has been estimated that steel mills in the United States buy about 5,000,000 tons of No. 2 sheet scrap a year for remelting purposes in open-hearth furnaces. Most of this scrap is purchased from dealers who hydraulically compress a large proportion of it into bundles, usually about 20 by 24 up to 30 in. in size, and ship it to the mills in railroad gondola cars.

In recent months, operating personnel at some of the steel mills have become alarmed at the low yields from metallics charged into their furnaces. Test heats showed that No. 2 bundled scrap was the cause of the low yields. Intensive internal bundle inspection measures were introduced and startling revelations were uncovered. Some bundles of scrap were found to contain a wide assortment of nonmetallic materials, including concrete blocks, bricks, tin cans, dirt, sand, grease, grindings, and sludge. The mills recognized the fact that scrap is not a manufactured product and some tolerance is allowed. However, it was apparent that there had been deliberate "loading" of bundles with nonmetallics by some dealers – a minority but enough to bring disrepute upon the entire scrap metal industry.

Shocked and aroused over these findings, steel men proposed drastic measures: some suggested hiring an army of inspectors to police all bundlers; others talked of putting their companies in the scrap business and thus become independent of dealers.

Bethlehem's Unique Solution

A booklet released recently by Bethlehem Steel Company tells how the Scrap Inspection Department at its Bethlehem, Pennsylvania, plants developed a quick, effective, and economical method of blasting with dynamite to open hydraulically compressed bundles of No. 2 sheet scrap for complete examination of their contents.

Bethlehem's experience had demonstrated that surface inspection was not too effective in determining the quality of purchased bundle scrap. Numerous

TYPICAL HOLE: A close-up of a hole 2 in. in diameter and 10 in. deep which was pierced into the center of one side of a bundle of hydraulically compressed No. 2 sheet scrap at the Bethlehem, Pennsylvania, plant of Bethlehem Steel Company. A paving breaker with a special tool is used in the hole-piercing operation.

PREPARING TO BLAST: After holes have been pierced into six selected bundles, the blaster loads a 1 by 8-in. cartridge of 30% ammonia gelatin dynamite, primed with an electric blasting cap, into each hole. The dynamite charge in each hole is stemmed with wet fire clay.

CORRODED BORINGS: Examination of this bundle after blasting disclosed a drum filled with rusty and corroded cast iron borings.

methods were used to open bundles for thorough inspection such as drilling, friction sawing, hand sawing, torch cutting, mashing, and cold shearing. All proved to be impractical for reasons of time consumption and low production, expense, or the distortion and destruction of the contents. After several earlier attempts to use explosives for the job, a method was developed in which small charges of dynamite were used to open the bundles without destroying or distorting the contents. The results from this unusual blasting with dynamite procedure have been consistently satisfactory.

The inspection of scrap at the Bethlehem plants is performed during daylight hours by two-man teams. Before leaving headquarters, each team is supplied with such information as railroad car numbers, order numbers, type of scrap, and the names of the shippers of the cars to be examined. Every car is given a careful top-of-car inspection. Whenever the contents appear to be below Bethlehem Steel Company's specifications, the car is consigned for reinspection. In the case of bundled scrap, a minimum of one out of four

TIN CANS: In this instance, internal inspection of a blasted bundle revealed tin cans wrapped with sheet steel, a typical example of "loading" a bundle.

cars from each shipper, regardless of appearance, is selected for further internal inspection. If the results of this spot checking indicate poor quality, every car from that shipper is given the internal inspection test.

Blasts Open Bundled Scrap Without Destroying Contents

The procedure for an internal inspection test follows through in the following order. The scrap inspector selects six bundles from each car, usually two from one end of the car, two from the middle of the car, and two from the opposite end. The selected bundles are placed on the ground adjacent to the car by a crane and magnet. A metal sign with the car number is placed with each set of bundles to insure identification.

The six sample bundles are made ready for blasting by piercing a 2-in.-diameter hole approximately 10 in. deep into the center of one side of each bundle. An Ingersoll-Rand paving breaker equipped with a special tool is used to pierce the holes. The blasting foreman loads one cartridge of 30% ammonia gelatin dynamite, size 1 by 8 in., primed with an electric blasting cap with 6-ft. leg wires, into each drill hole. The dynamite charges are stemmed with wet fire clay. When all the drill holes are loaded and stemmed, the cap leg wires from the six charges are connected in series and the blast is fired with a conventional blasting machine.

LOTS OF WOOD: After blasting an opening in this hydraulically compressed bundle, large quantities of wood were disclosed.

INSULATING MATERIAL: The blasting method opened this bundle to show the presence of heavy amounts of insulating material inside.

After firing a blast, the foreman returns to the area to determine whether all charges were detonated and if the bundles had been opened satisfactorily for internal examination by the scrap inspector. The blasting produces an opening in each bundle sufficiently large to permit complete internal inspection of the contents.

Bethlehem Steel Company's application of dynamite to the solution of a costly and troublesome problem is significant, because it again demonstrates the effectiveness of explosives when used scientifically. The time saved and the economies effected are inherent advantages of modern industrial explosives.

Accelerating Fill Settlement WITH EXPLOSIVES On a Massachusetts Highway

Skillful blasting with industrial explosives enables a contractor to stabilize highway fill over a peat swamp composed of fibrous, spongy material 20 to 40 ft. deep

HOLLIS F. CHURCH, JR.*

THE Department of Public Works, District II, of the Commonwealth of Massachusetts received bids October 21, 1952, for grading, draining, and surfacing a section of highway in Holyoke, Massachusetts, on the Easthampton road. Ordinarily, such a job would be a routine assignment for experienced road builders. However, the specifications on this project included settling a highway fill over a swamp 650 ft. long, consisting of fibrous, spongy peat and muck 20 to 40 ft. deep. From past experience, the state authorities decided that it would be impractical, if not impossible, to excavate such a depth of this type of peat with mechanical equipment. Accordingly, the bid proposals provided for contractors to submit bids based on two methods of settling embankments across deep swamp or marsh area, namely, by blasting with explosives or by the sand-drain method.

A public reading of the bids revealed that the contracting firm of Cooke-Ross, Incorporated, Torrington, Connecticut, was the low bidder at $47,229.25, using the blasting method as the basis of the bid. In due course, the contract was awarded to Cooke-Ross, Incorporated, to do the work.

Early Methods Unsuccessful

For many years, at varying intervals, Holyoke city officials had autho-

*Hercules Powder Company
500 Fifth Avenue, New York 36, N. Y.

BLASTING DITCHES: Two relief ditches, each 75 ft. long, were blasted simultaneously in the peat and mucky soil along each side of the original roadway.

ORIGINAL ROADWAY: The top of a 650-ft. section of the Holyoke-Easthampton highway in Massachusetts was about level with the top of a peat and muck swamp.

FIRST FILL: After the roadway was grubbed with a bulldozer, an embankment of pervious material was placed over the swamp section. Trees on both sides were cut down.

DEEP, WIDE DITCHES: The propagated method of blasting with 60% nitroglycerin dynamite produced ditches on both sides of the road 7 ft. deep, 7 ft. wide at the bottom, and 21 ft. wide at the top. Blasting the two ditches required 3,100 lbs. of dynamite.

rized the placing of fill on the surface of the road to raise the section over the swamp up to grade. The material they used as fill consisted of crushed stone, gravel, and granular material. Gradually, the fill would sink and the surface of the road would be lowered below grade, about 15 ft. in the center and on the east end, and approximately 5 ft. on the west end. During 1952, the grade of the surface of the road had sunk until it was about level with the top of the swamp.

Estimates by state engineers, computed vertically from the foot of the slope of the road embankment, after deducting the old fill, indicated that the swamp contained a net quantity of about 15,000 cu. yds. of peat. Examinations revealed that the peat was a fibrous material of a spongy nature.

Many large trees with heavy roots and accompanying vegetation were present on both sides of the road. Because of this, the contract plans called for relief ditches to be blasted on both sides of the roadway, after a fill of pervious material had been placed on the surface of the existing road. Each ditch was to be 630 ft. long, and of sufficient depth and width to facilitate the displacement of the peat when blasts were fired under the fill that had been placed on the road.

Blasting Relief Ditches

The ditches were blasted in a series of individual blasts 75 ft. long, comprising six to nine holes each. The holes were punched into the mucky soil, 6 ft. deep and 2 ft. apart, along the center line of each ditch. Each hole was loaded with eight cartridges of Hercules 60% Nitroglycerin Dynamite in 1¼ by 8-in. cartridges. This charge filled the hole to within 1 ft. of the collar. The dynamite in one hole was primed with a Hercules Electric Blasting Cap and the blast was fired by a 50-hole blasting machine. This method of propagated blasting produced ditches 7 ft. deep, 7 ft. wide at the bottom and 21 ft. wide at the top. The total dynamite required for blasting the two ditches alongside the roadway was 3,100 lbs.

After a substantial length of the relief ditches had been blasted, a well drill was brought to the job to drill

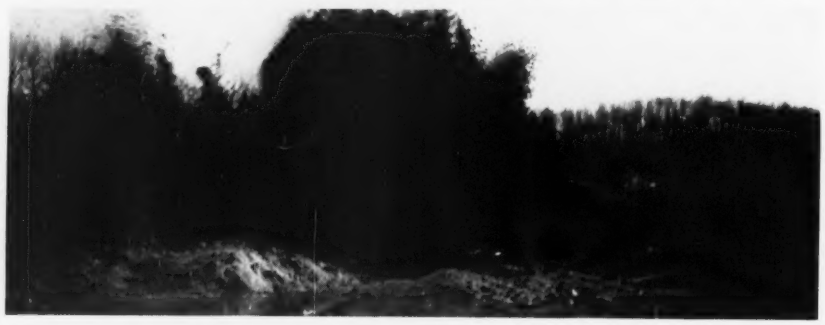
6-in. holes through the fill and conglomerate material that had been placed on the surface of the old road. After a day and a half of operations, only four holes had been drilled in the shallow end of the swamp. It was practically impossible to load them with explosives. The contractor discontinued the use of the well drill and introduced a truck-mounted wagon drill equipped with 1½-in. steel and 4-in.-diameter Carbide bits. Approximately one hole an hour was realized with the wagon drill.

Blasting Under the Fill

The procedure in blasting under the fill on the road was as follows:

With the drill equipped with 18-ft. steel, a hole was put down through the fill, sand, and old road surface material. The steel was then changed to a 30-ft. length which was drilled down through 6 to 10 ft. of the muck. The hole was encased or lined with a 24-ft. length of 3-in. pipe, using the drill hammer as a pile driver. After the casing was in place, the hole was cleaned out by means of compressed air and a blow pipe. One 2 by 24-in. cartridge of 60% gelatin extra dynamite primed with an electric blasting cap was loaded into the bottom of the hole and fired. This preliminary blasting, referred to as springing the hole, made a pocket in the bottom of the hole below the casing. Additional holes were drilled and sprung in the same manner, with the holes spaced on 10- to 12-ft. centers.

DRILLING THROUGH THE FILL: Using a wagon drill, 4-in.-diameter holes were driven through the fill and 8 ft. of the muck. The holes were encased with 24-ft. lengths of 3-in. pipe.



BLASTING UNDER FILL: For blasting under the fill to displace 15,000 cu. yds. of peat, the contractor used a loading ratio of .75 lbs. of 60% gelatin extra dynamite per cu. yd. of material in place. Excellent results were realized.

AFTER THE LAST BLAST: This view of the roadway was photographed ten minutes after the final dynamite blast was fired under the fill. From 75 to 175 lbs. of 60% gelatin extra dynamite, primed with electric blasting caps, were loaded into each drill hole, the amounts varying to conform with the burden over the holes.

OPERATING PERSONNEL: Left to right, S. Guerra, Cooke-Ross, Inc.; D. L. Costello, district state aid engineer; K. Rich, resident engineer; A. Gore, P. Cooke, and M. Di Leo, Cooke-Ross, Inc.; H. F. Church, Jr., Hercules Powder Company.

PROJECT COMPLETED: With pervious fill material firmly seated on the bottom of the swamp area and the surfacing of the new roadway completed, a troublesome highway problem in Holyoke, Massachusetts, on the Easthampton road, was solved.

At the end of the day, each hole was loaded with from 75 to 175 lbs. of dynamite, the amounts varying to conform with the burden over the holes. The dynamite charge in each hole was primed with two electric blasting caps and the holes were stemmed to the collar with sand. Blasts were fired with a 50-hole blasting machine.

For blasting under the fill to displace 15,000 cu. yds. of peat, the dynamite-loading ratio was approximately .75 lb. per cu. yd. of material in place. This was a slightly higher explosives loading ratio than the preliminary estimate of .5 lb. per cu. yd. The increase was due primarily to the profile of the bottom of the swamp. Blasting under the fill was begun at the shallow end and progressed toward the east or deeper end. As the depth of the fill increased, it was difficult to determine from the results of one blast what would be required for satisfactory results in the next succeeding blast. Rather than risk the possibility of not settling the fill to the bottom of the swamp, it was decided to load the dynamite charges on the high side rather than on the low side. The excellent results obtained justified this decision.

Once again, the scientific application of industrial explosives provided an effective, economical solution to a difficult construction problem.

Radio Frequency Energy—A Potential Hazard in the Use and Transportation of Electric Blasting Caps

When they are in operation, all transmitters of radio and the related radio-frequency (RF) services, such as television and radar, create a field of electrical energy in the air surrounding their antennas. It has been found that, under exceptional circumstances, electric blasting caps may pick up enough of this energy to cause them to explode.

Magnitude of the RF Energy Hazard

From a practical standpoint, the possibility of a premature explosion due to RF energy is extremely remote. This has been demonstrated by numerous tests on representative transmitting equipment, and it is confirmed by many years of experience. The annual consumption of electric blasting caps is well over 100 million, and they are used in every section of the country. Yet there has been only one authenticated case of a cap being *accidentally* fired by radio.

All types of RF energy receivers are harmless, and there is also no danger from the transmitters in the case of explosives that are not directly actuated by electricity; for example, fuse-type blasting caps, the detonating fuses such as Primacord,* and dynamite.

How RF Energy Can Fire An Electric Blasting Cap

The wires on an electric blasting cap, or in an electric blasting circuit, can act as an antenna. If the configuration of the wires is just right, and if the radio transmitter is close enough, this antenna may pick up enough current to cause detonation.

A peculiar feature of radio frequency current is the fact that the actual current varies at different points along an antenna, and is at a maximum at certain points and zero at others, varying continuously in between. If the electric blasting cap wires are acting as an antenna, therefore, the greatest danger exists when the cap is located at a point where the induced current is at a maximum.

*Reg. U. S. Pat. Off. by The Ensign-Bickford Company.

†The radio wave length in feet is approximately 1,000,000 divided by the frequency in kilocycles or 1,000 divided by the frequency in megacycles.

Conditions Required for Maximum Current Pickup

So far as wire lengths are concerned, the hazard is greatest with (1) a straight length equal to one-half the radio wave length,† or a multiple thereof, with the cap in the center, and (2) a straight length equal to one-quarter the radio wave length, or an odd (3, 5, etc.) multiple thereof, with one end grounded and the cap near that end.

Other conditions required for maximum current pickup are that the wires are (1) parallel to the transmitting antenna and in its zone of maximum radiation, and (2) raised a few feet above the ground.

Effect of Transmitter Type

Commercial amplitude-modulated (AM) transmitters are potentially the most dangerous. This is because they combine high power, low frequencies, and in some cases horizontal antennas. The latter are objectionable because most blasting circuits are also horizontal, and low frequencies induce more current than high frequencies.

Frequency-modulated (FM) radio and TV transmitters are very unlikely to create a hazardous situation. Although their power is often high, they employ high frequencies with a flat radiation pattern, and their antennas are so located (usually on top of the tallest available building) that any nearby blasting operations would be fairly well shielded.

Mobile radio must be rated as a potential hazard because, although its power is low, it can be brought directly into the blasting area. Actually, however, there is little chance that mobile radio could cause a premature explosion. In addition to its low power, the favorable factors are vertical antennas and high frequencies.

There is also little possibility that other sources of RF energy such as amateur radio, microwave relay, radar, Loran, etc., will ever constitute a practical problem. They are all characterized by one or more of the following: (1) location in areas where blasting is unlikely, (2) low power, (3) very high frequency, and (4) restricted radiation patterns.

The table appended hereto gives the pertinent data with respect to most types of RF transmitters.

Distance from Transmitter — Recommended Table

RF energy decreases as the square of the distance from the transmitter. Thus it is obvious that there must be some minimum distance beyond which it is safe to conduct electric blasting operations even under the worst of conditions. The following minimum distances, based on the power of the transmitter, are recommended by the Institute of Makers of Explosives.

Transmitter Power (Watts)	*Minimum Distance (Feet)*
5-25	100
25-50	150
50-100	220
100-250	350
250-500	450
500-1,000	650
1,000-2,500	1,000
2,500-5,000	1,500
5,000-10,000	2,200
10,000-25,000	3,500
25,000-50,000	5,000
50,000-100,000	7,000

The accompanying article, a reprint of the Institute of Makers of Explosives pamphlet No. 20 entitled "Radio Frequency Energy — A Potential Hazard in the Use and Transportation of Electric Blasting Caps," contains the most up-to-date information on this subject available to the Editors at the present time. It supersedes and makes obsolete an article "Electric Blasting Circuits—Hazards from Radio Frequency Energy," by Dr. R. W. Lawrence, in the September-October, 1951, issue of The Explosives Engineer.

The above table assumes the most hazardous conditions, and also includes a substantial margin of safety. Nevertheless, electric blasting should not be carried out at lesser distances from the transmitter unless it has been determined with certainty that there actually is no danger.

Determining the Extent of the Hazard

The minimum firing current of the commercial electric blasting caps now manufactured in this country is about 0.25 ampere. It is strongly recommended, however, that nonelectric initiation be used if a current-testing device shows more than 0.06 ampere.

The most satisfactory testing device is a radio-frequency ammeter. If one is not available, however, a pilot lamp which lights up brightly at 0.06 ampere may be substituted. The No. 48 pilot lamp meets this requirement at the present time.

In the case of any particular shot, a dummy electric blasting circuit should be laid out and the test device inserted successively in place of each cap. On the other hand, in surveying a blasting area or testing a transmitter, it is obvious that conditions should deliberately be made as hazardous as they ever conceivably could be. The dummy circuit, therefore, should consist of a straight piece of wire of exactly half the radio wave length* with the test device in the center of the wire. The assembly should then be held several feet off the ground, parallel to the transmitting antenna and as close to it as any blasting would ever be done. As has been stated previously, electric blasting is not recommended if the test device indicates 0.06 or more ampere.

The presence of a microwave radar beam can most readily be detected by means of a 2-watt neon glow lamp, such as the present NE-34 or NE-36. It has been found extremely difficult to fire electric blasting caps by means of radar; nevertheless, it is advisable to keep them out of a radar beam.

*Due to end effects, the wave length is sometimes slightly less than the figure obtained in dividing 1,000,000 by the frequency in kilocycles, or 1,000 by the frequency in megacycles. It is good practice, therefore, to start with the calculated wire length and then cut off short lengths from each end until the maximum current is reached.

RADIO TRANSMITTING STATIONS

Partial List

COMMERCIAL BROADCAST

Type	*Frequency*	*Wave Length*	*Power*
AM	540 - 1,600 kilocycles (0.54 - 1.6 megacycles)	1820 - 615 ft.	Up to 50,000 watts
FM	88 - 108 megacycles	11.2 - 9.1 ft.	Up to 550,000 watts
TV	50 - 88 megacycles	19.7 - 11.2 ft.	Up to 50,000 watts
	174 - 216 megacycles	5.6 - 4.5 ft.	Up to 50,000 watts
	470 - 890 megacycles	2.1 - 1.1 ft.	

AMATEUR

1.8 - 2.0 megacycles	545 -490 ft.	
3.5 - 4.0 megacycles	280 -246 ft.	Up
7.0 - 7.3 megacycles	140 -135 ft.	
14.0 - 14.4 megacycles	70.0 - 68.2 ft.	to
26.96 - 27.23 megacycles	36.6 - 36.0 ft.	
28.0 - 29.7 megacycles	35.1 - 33.0 ft.	1,000 watts
50.0 - 54.0 megacycles	19.7 - 18.2 ft.	
144 - 148 megacycles	6.8 - 6.65 ft.	
220 - 225 megacycles	4.46- 4.36 ft.	

(and others scattered in the range 1,215-30,000 megacycles)

TWO-WAY COMMUNICATIONS SYSTEMS

Low-Frequency Range

25 - 50 megacycles	36 - 18 ft.	
Central Station		Up to 500 watts
Mobile Unit		1-100 watts

High-Frequency Range

148 - 174 megacycles	6.3 - 5.3 ft.	
Central Station		Up to 600 watts
Mobile Unit		1-50 watts

RADAR

(Representative Types Used in Connection with Ship Navigation and Aviation)

Loran	1.8 - 2.0 megacycles	545 - 490 ft.	
Shoran	210 - 320 megacycles	4.7 - 3.1 ft.	
Microwave	3,000 megacycles	10 cm.	
Microwave	10,000 megacycles	3 cm.	

Mobile Transmitters

Under favorable conditions, electric blasting can be carried out with complete safety at distances considerably less than those listed in the table of distances. This fact is of particular importance in the case of mobile radio; in other words, it would often be unrealistic to restrict the operation of these transmitters to the same limits as for much more hazardous devices. No mobile system should be approved, however, unless it has been shown without question that no danger exists.

Transportation

All available evidence indicates that radio is not a hazard in the transportation of electric blasting caps so long as they are in their original containers. This is because the wires are then coiled or folded in a manner which provides highly effective protection against current induction. Furthermore, almost all truck bodies and freight cars are made of metal and this virtually eliminates the penetration of RF energy.

If vehicles equipped with radio transmitters are used in transporting electric blasting caps to or from a job, it is recommended that (1) they be carried in a closed metal box, and (2) the transmitter be turned off when the caps are either being put into or taken out of the box. To protect against shock and friction, the metal box should be lined with a soft material such as wood or sponge rubber.

PUERTO RICO'S WATER SUPPLY PROJECT

The development of a multiple-purpose construction project to provide for irrigation, water supply, hydroelectric power expansion, and flood control in the southwestern region will lead to large economic gains throughout the Island

ALBERT S. KESHEN*

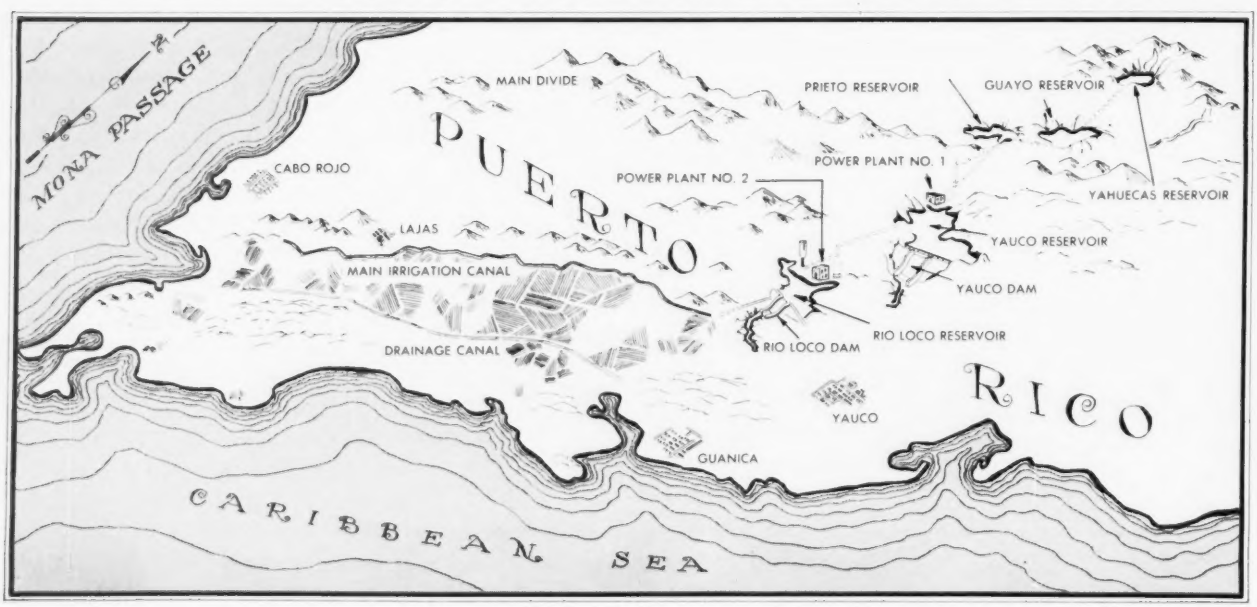
MANY years ago, Puerto Rico was described by the Spaniards who landed there as the land of rivers. This description is still appropriate, for the Island's average rainfall is 68 in. annually; in some sections, it reaches a high of 250 in. However, this rain water is unevenly distributed – some parts of the Island get too much of it while others receive too little.

The heaviest rains occur in the mountains and, at times, water runs off them in veritable torrents to form the larger rivers of the coastal plains. Most of this rain water falls on the northern slopes. This is because the central range of mountains, crossing the Island from east to west, precipitates the moisture carried by the northeast trade winds. As a result, the south coast and, to some extent, the northwestern elevated coastal area extending from Arecibo to Isabela are characterized as the arid regions of Puerto Rico. Surface water for industrial, municipal, and domestic use is provided by 51 rivers and 1,200 streams. This surface water also offers excellent opportunities for irrigation purposes and for the development of hydroelectric power.

The correction of this unbalanced distribution of rain water required action by the Island's governmental authorities, since cooperative action by land owners would not be sufficiently effective to achieve the results desired.

*58 Demarest Street
Newark 8, New Jersey

THE SOUTHWESTERN PROJECT: Upon completion in June, 1955, Puerto Rico's Southwestern Project will provide reservoirs and conduits for the collection of the runoff from 70 sq. mi. of mountainous drainage areas located northeast of the Island's Lajas Valley.



In 1908, the insular authorities initiated the Public Irrigation Law. It incorporated large areas into cooperative districts and made possible the financing of large storage reservoirs, canals, and control work.

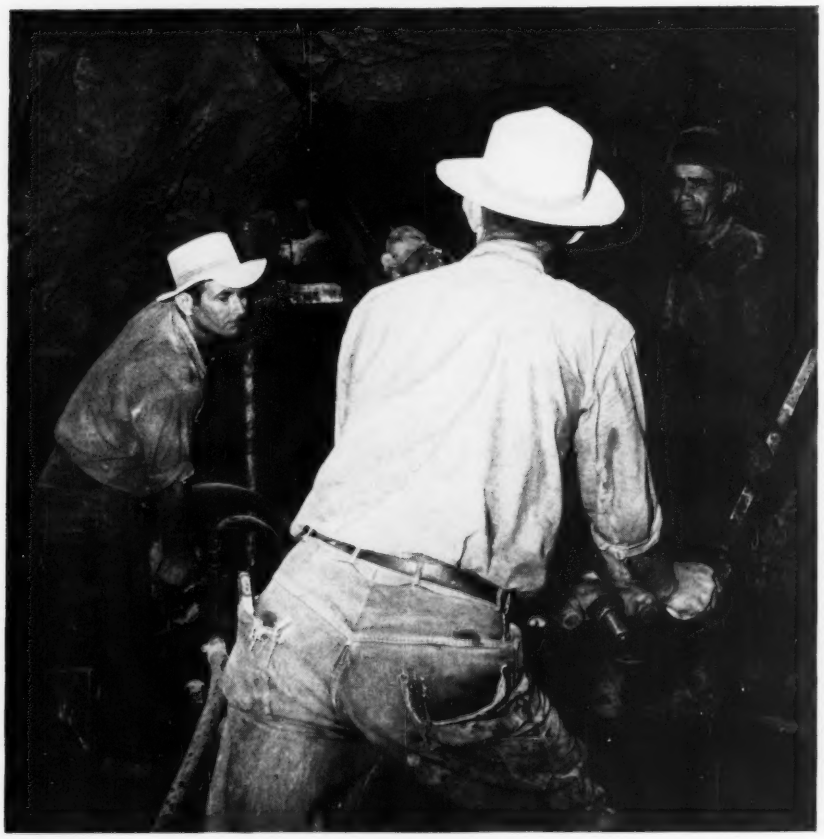
The Government's Objectives

The government's subsequent development of a multiple-purpose project for irrigation, water supply, power expansion, and flood control in the southwestern region is expected to lead to large economic gains in that region and in the Island as a whole. The completion of the project will create new living space, attract new industry and commerce, add to and conserve agricultural lands of great value, provide employment for additional thousands of people, and raise the standard of living of everyone in the area.

Two stages of this program have been completed. The first stage provides for the irrigation of 51,000 acres of land on the southern coast. The second, the Isabela Irrigation Service, irrigates about 8,300 acres of land in the northwest corner of the island. The third stage, the Southwestern Project, is now under construction.

GUAYO DAMSITE: This is the location selected by the Puerto Rico Water Resources Authority for the construction of Guayo Dam, designed as a concrete structure of the gravity type 200 ft. high and 600 ft. long, requiring the placement of 120,000 cu. yds. of concrete.

PREPARING TO DRILL: Some drill operators at work setting up a drill jumbo preparatory to blasting a round in one of the tunnel headings on the Island's Southwestern Project.



Specifically, the principal objectives of the Southwestern Project include the reclamation and preservation of 26,000 acres of agricultural lands; the development of 6½ million gallons daily of potable water to supply the towns in southwestern Puerto Rico; the addition of about 100 million kilowatt-hours of hydroelectric energy per average water year to supplement the supply for the increasing electric power demand; and to provide some protection from floods for property in the Yauco, Anasco, and Loco River basins.

All of the objectives are in line with the government's present effort to strengthen the industrial economy, to offset dependence on agriculture, and to keep pace with the Island's population growth. The program, known as Governor Munoz's "Operation Bootstrap," was started in 1948 under the direction of the Puerto Rico Development Administration, a government agency. More than 225 new factories have already been established. The goal is 700 factories within ten years.

The Project at Yauco

The Southwestern Project at Yauco was begun by the Puerto Rico Water Resources Authority in 1948 and completion is expected in June, 1955. It

LINING FAULT ZONES: This picture, taken inside one of the many tunnels under construction, shows workmen placing forms for the lining of fault zones.

will provide reservoirs and conduits to collect the runoff from 70 sq. mi. of mountainous drainage areas located in the southwest central region of the Island, northeast of the Lajas Valley. Most of the runoff will be collected from a watershed of 40 sq. mi., located north of the main divide in a region where the rainfall is unusually heavy. The waters will be diverted and carried through the divide by means of 43,400 ft. of tunnels, at an elevation sufficiently high to develop a gross power head of 900 ft. before entering a storage reservoir on the Yauco River.

The flow from this storage reservoir, together with the runoff from the watersheds of the upper Yauco and Duey Rivers, will be diverted through a pressure tunnel about 15,300 ft. long to a second power plant in the upper reach of the Rio Loco Reservoir, developing 340 ft. of power head. The total water yield, supplemented by the runoff from 8 sq. mi. of the Rio Loco watershed, will be made available for irrigation by gravity to the Lajas Valley area.

Progress to Date

At the time of the writer's visit in February, 1953, the Southwestern Project had progressed as follows: The Yauco Dam and the tunnel from the Yauco Reservoir to the Rio Loco Reservoir had been completed. Construction work on the Rio Loco Dam was begun in July, 1952. The first section of irrigation canals in the system is now in the course of construction. The Guayo-Prieto-Yauco tunnel is being driven for a length of 36,000 ft. with operations at three headings—two end headings and one intermediate heading, the latter accessible through a construction adit.

Large stocks of dynamite are maintained at all times to eliminate the possibility of work shutdowns because of insufficient supplies for large-scale blasting activities. The dynamite is shipped to the Island in boats from the United States. A Puerto Rico Government regulation restricts the unloading of shiploads of dynamite in San Juan Harbor to 40,000 lbs. each. Previous to the adoption of this regulation, up to 200,000 lbs. could be unloaded in the harbor at one time. Under present conditions, frequent shipments of dynamite from the mainland have to be made in order to carry on successfully a construction project of this magnitude.

The cost of the overall project is

INLET PORTAL: The inlet portal of the Guayo-Prieto-Yauco tunnel provides access to the bore which, when this picture was taken, had progressed to a length of 10,371 lin. ft.

estimated at $32,000,000. The Puerto Rico Resources Authority is doing all of the construction work on dams, tunnels, surge shafts, penstocks, and powerhouses, as well as providing the details of design. The hydroelectric part of the work is being done by force account. Irrigation ditches are being constructed under a contract awarded to Southern Construction Corporation of Ponce, Puerto Rico.

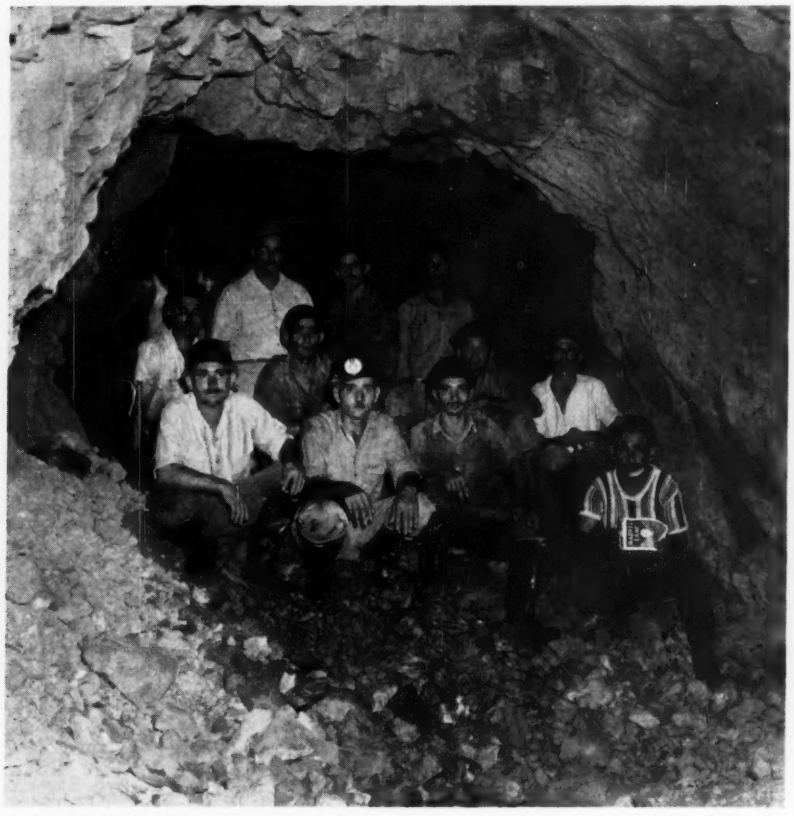
Explosives Requirements

Construction work requiring the use of explosives includes the building of five dams of the concrete gravity type, ranging from 60 to 200 ft. in height; the driving of 65,000 lin. ft. of tunnel varying in size from 8 to 11 ft. in diameter; the erecting of two hydroelectric power plants, one of 10,000-KVA capacity, 310 net head, and the other of 25,000-KVA capacity, 740 net head; and the constructing of irrigation and drainage systems for the improvement of 2,600 acres of land. Most of the rock encountered on these various jobs is volcanic, of the andesitic type. One of the tunnels, the Yauco-Loco, traverses a serpentine formation at the low 2,000-ft. level.

OUTLET PORTAL: A view of the outlet portal of Yauco-Laco tunnel at the powerhouse site. The derrick on the top of the hill is employed in the excavation for the surge shaft.

The drills used in tunnel-driving operations are Gardner-Denver CF99 drifters mounted on a Gardner-Denver model JABBT jumbo, and DA-35 I-R drifters mounted on a DJB2 jumbo. Occasionally, CF 89H Gardner-Denver drifters are used. The drills are equipped with 1¼-in. drill steel and Timken detachable bits. In the harder rock formations, carbide insert bits are employed. Air compressors include four Worthingtons, type DC 2, 1,500-c.f.m.; two Burys, type VCCE, 1,000-c.f.m.; and several Chicago Pneumatic and Gardner-Denver units with 500-c.f.m. rated capacity.

AFTER HOLING THROUGH: A group of supervisors and workmen pose for a picture following the holing-through of one of the sections of the Yauco-Laco tunnel.



Two Types of Dynamite

The drill holes are loaded with a semigelatin grade of dynamite with a bulk strength of 60%, packed in 1¼ by 8-in. cartridges. An average round for tunnel blasting is loaded on the basis of 4.72 lbs. of dynamite per 1 cu. yd. of material in place, or 19.54 lbs. per 1 lin. ft. of tunnel. The charges are primed with No. 8 electric blasting caps and delay caps, from first through third delay periods. The leg wires of the detonators are hooked up in a straight parallel connection. Blasts are fired from a 220-volt A.C. power line.

The progress being made on the project is reflected in some statistics for the outlet portal section of Prieto-Yauco tunnel from the start of work in

(Continued on page 123)

THE AFTERNOON CREW: Just before going on shift in the Evan Jones coal mine, the afternoon crew paused briefly to be photographed beside the mine entrance. Despite a combination of transportation and weather problems, current employe requirements total more than 250.

The Evan-Jones Coal Mine

(Continued from page 107)

Clean coal from the jig is screened on an Allis Chalmers low-head, three-deck vibrating machine where it is sized and dewatered. The top deck of the screen is 10 by 4 ft., with 1½-in. holes. The center deck is 10 by 4 ft., with 20-mesh dewatering cloth. The bottom deck catches water and returns it to the sump.

Clean coal from the vibrator top deck is chuted to a bin which feeds to the railroad cars. Processed minus 1½-in. coal from the middle deck is moved by an 18-in. conveyor belt to any one of five bins which have feed outlets to railroad coal cars.

Production Up 35 Per Cent In Two Years

The introduction of modern mining equipment and methods and the capable management at the Evan Jones coal mine are key factors in the forward strides taken by the Alaskan coal

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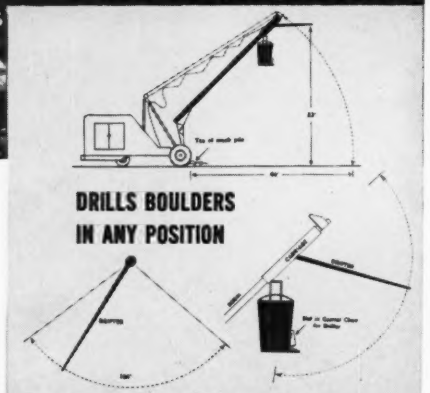

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industry in recent years. The 35 per cent increase in coal production during the last biennium over the previous two years is mainly due to the increased output at the Evan Jones mine.

In general, gold has been Alaska's chief claim to fame in the mining world. However, the day is not far distant when the Evan Jones Coal Company, allied with the territory's other coal producers, will have carved an important niche for Alaska in the mining industry.

Photographs by William Buxton and Manuel Sweazy

Puerto Rico Water

(Continued from page 121)

July, 1949, through January, 1953.

Number of 8-hr. shifts	2,406
Progress, lin. ft.	17,177
Blasts fired	2,688
Dynamite, lbs. fired	334,991
Progress per blast, lin. ft.	6.39
Muck removed, cu. yds.	71,981
Excavation, cu. yds. per lin. ft.	4.16

The loading out of the blasted material is accomplished by the employment of an Eimco No. 40 rocker shovel which empties into 90-cu. ft. Granby-type cars, and four Eimco No. 21 loaders which dump into 45-cu. ft. Granby-type cars. The loaded cars are hauled outside by Atlas 5-ton Type A storage battery locomotives.

This brief summary of the work that has been, and is being, done in Puerto Rico by the Water Resources Authority is representative of the expanding stature of the Island – politically, economically, and strategically. It also has helped to further strengthen Puerto Rico's relations with the United States, both for the advancement of peace throughout the world and in the event of future wars.

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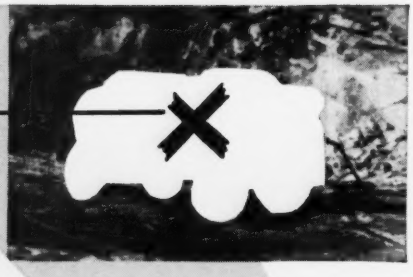

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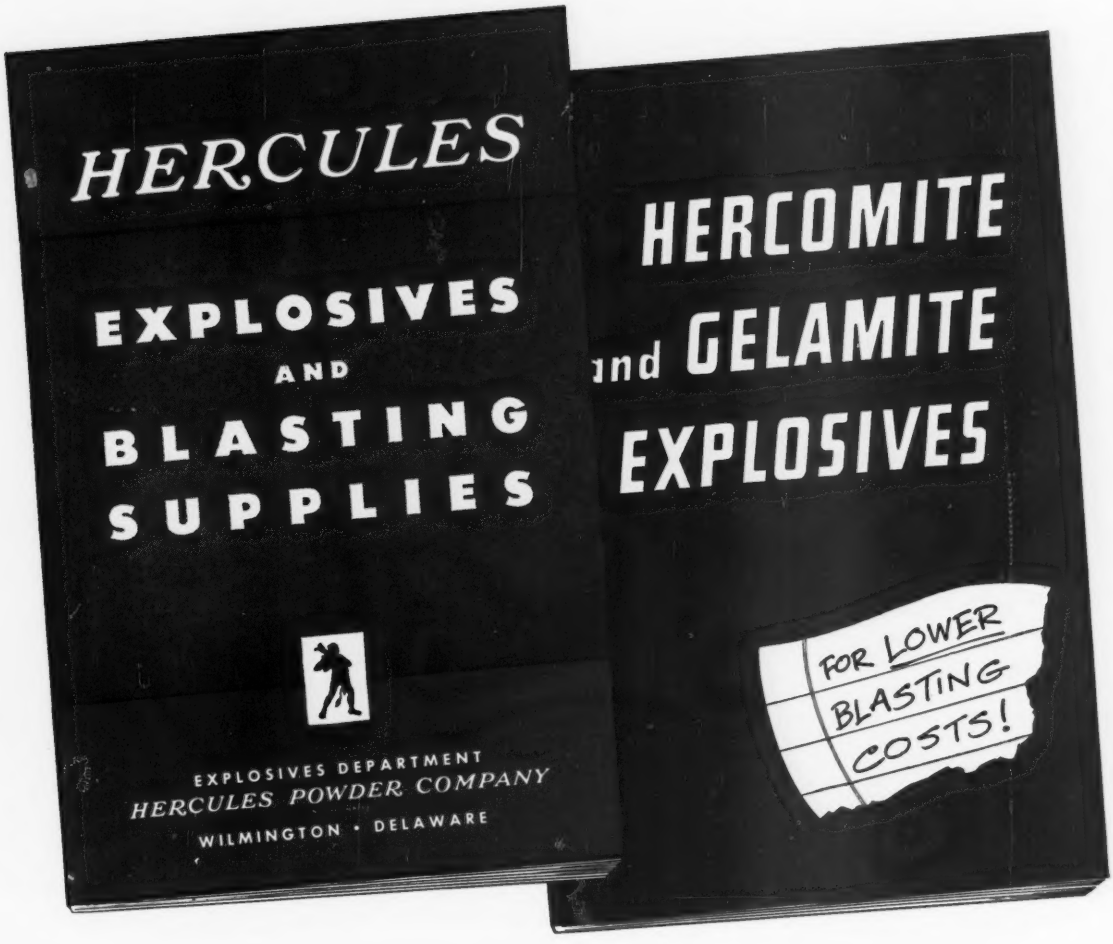

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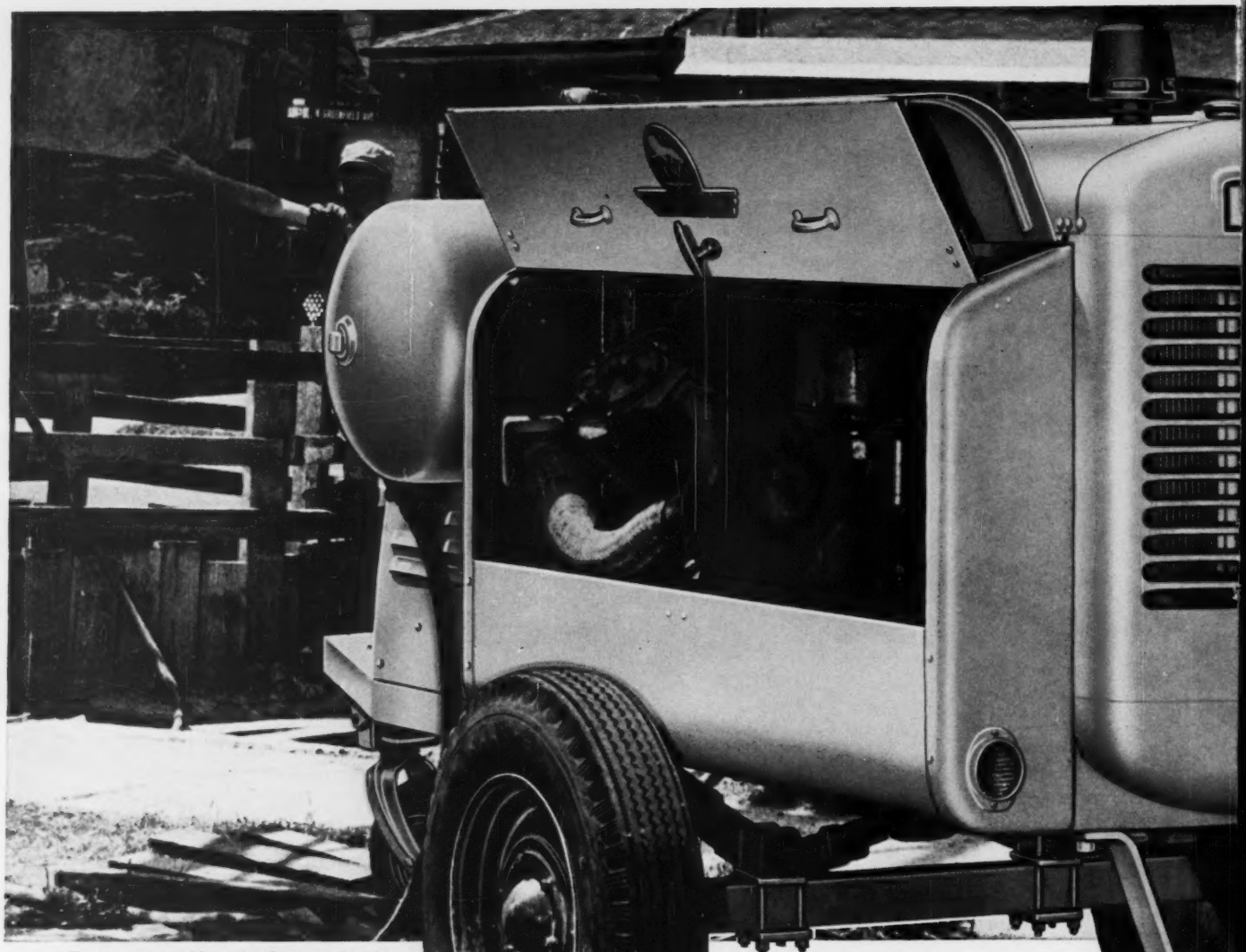

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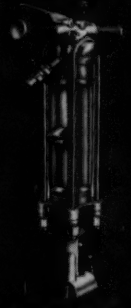

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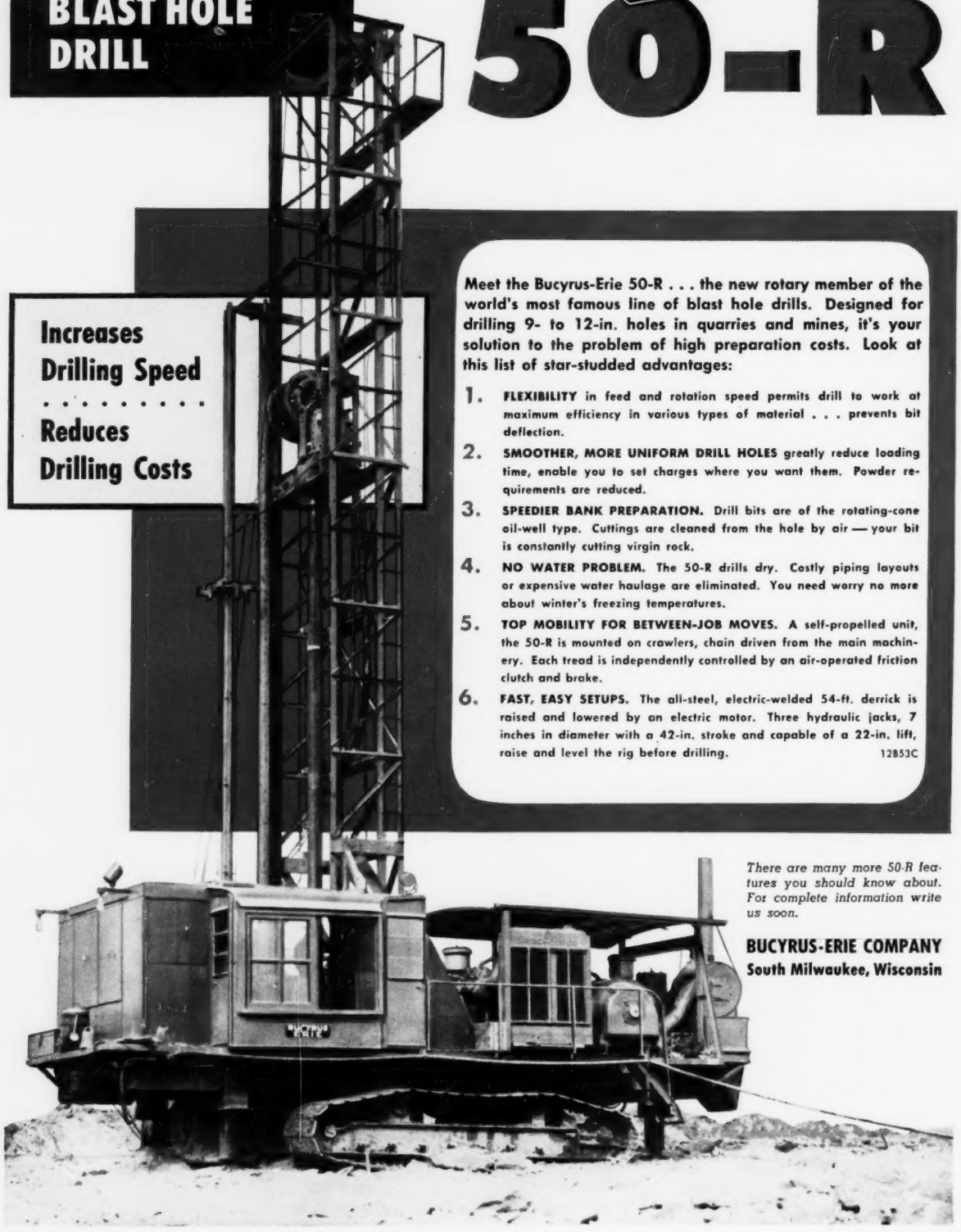

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